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Invaded habitats
Chapter 4

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Abstract

More than 65% (1040 species) of arthropod species alien *to* Europe are associated with human-made habitats, especially parks and gardens, human settlements and agricultural lands, whereas woodlands are yet colonized by less than 20% of the alien fauna, which still has a negligible representation in the other natural and semi-natural habitats. Large differences in habitat affinity are observed between alien taxonomic groups. Phytophagous species are predominant among aliens, representing 47.2% of species alien *to* Europe.

Keywords

alien, arthropod, habitat, Europe, level of invasion, urban, semi-urban

4.1 Introduction

The lack of a general assessment on the level of habitat invasion in Europe has up to now limited the possibilities of evaluating the risks arthropod invaders pose to different habitats. Such an assessment is a fundamental component of early detection and identification of those environments that are more prone to invasion, that will provide a baseline for optimizing actions to prevent, monitor and control invasion (Pyšek et

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al. 2010). For that reason, here we present a synthesis of the data on habitat preference of terrestrial arthropods alien *to* Europe compiled from chapters 7-13 of this book, providing an overview of which habitats are most invaded in Europe, and to assess differences among alien taxa in terms of habitat affinity.

We compared the numbers of established alien species occurring in 11 European habitats defined according to the European Nature Information System, level 1 (EUNIS) (Davies et al. 2004). This standard classification of European habitats has been chosen as a platform in several different studies on biological invasions in Europe (Chytrý et al. 2008, Daisie 2009, Pyšek et al. 2010). In this classification, a 'habitat' is defined as '*a place where plants or animals normally live, characterized primarily by its physical features (topography, plant or animal physiognomy, soil characteristics, climate, water quality, etc.) and secondarily by the species of plants and animals that live there*' (Davies *et al.*, 2004). Appendix II presents the different habitat types used throughout the taxa chapters. For more convenience, our analysis grouped them into the following broad categories roughly corresponding to the level I of EUNIS: coastal habitats (EUNIS class B); wetlands and riparian habitats (C); mires (D); grasslands (E); heathlands, hedgerows and shrub plantations (F); woodlands (G); cultivated habitats (I1); parks and gardens (we grouped the classes I2 and X11, X22, X23, X24, X25); and urban settlements (J) to which we added a specific code for greenhouses (J100). These broad categories may not precisely reflect the habitat(s) actually colonized by some species, but their use standardizes comparisons between very different taxa such as arthropods, plants and vertebrates.

The habitats in the system adopted here differ considerably in the number of alien arthropod species they contain. Aliens show a strong affinity for the habitats intensively disturbed by human activities (Figure 4.1.). Considering all established alien terrestrial arthropods, the highest percentage occurs in parks and gardens (500 out of the 1590 alien species found in Europe- 31.4%) and in human settlements (31.0 %), whilst slightly less occur in cultivated habitats, which host 29.7% of these alien species. Altogether, human-made habitats host 65.4% (1040 species) of the fauna of arthropods alien *to* Europe, most of these species being likely to occur in several different habitats. In contrast, less than 10% of the alien species have yet colonized natural and semi-natural habitats such as wetlands, riparian habitats, grasslands and heathlands, and less than 20% occur in woodlands and forests (Figure 4.1). These results confirm the analysis of Roques et al. (2009) which relied on a lower number of alien arthropod species. Pyšek et al. (2010) also stated that alien plants are mostly found in human-made, urban or cultivated habitats, unlike vertebrates, which are more evenly distributed among habitats, the most invaded of which are aquatic and riparian habitats, woodland and cultivated land.

Some habitats are differentially preferred by certain taxonomic groups (Table 4.1). For instance, many alien species are pests of ornamental plants in parks and gardens. In particular, mites are an important group attacking urban trees, shrubs and flowering plants. More than 40% of alien mites are observed in this habitat. Similarly, alien hemipterans, especially aphids, and lepidopterans have colonized parks and gar-

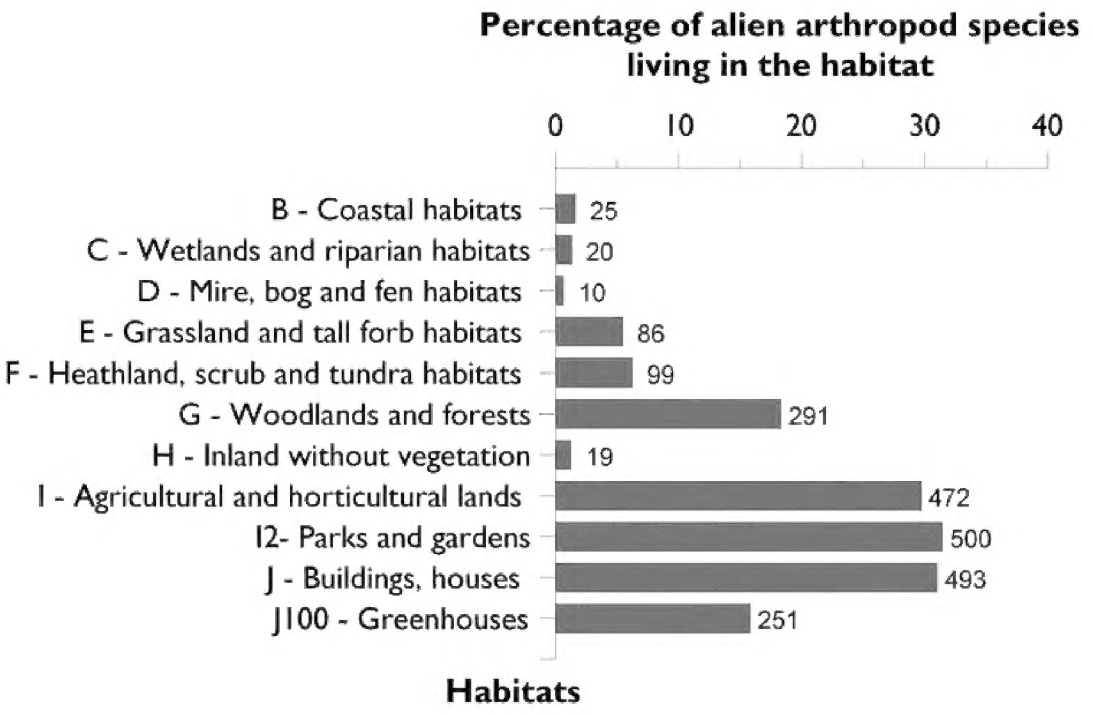

Figure 4.1. Main European habitats colonized by the 1590 species of terrestrial arthropods alien *to* Europe. The number over each bar indicates the absolute number of alien species recorded per habitat. Note that a species may have colonized several habitats.

dens effectively, 78.9% and 56.7% of their species being observed there, respectively (Table 4.1).

Built-up, industrial and other artificial habitats are invaded to a high degree by spiders. Indeed, more than 90% of the alien spiders are found in buildings. Psocoptera is another well-represented group in this habitat with 81.6% of its alien species in Europe occurring there, as is Phthiraptera (67.7%) and Coleoptera (57.3%), a number of species of the latter group being associated with stored products. By contrast, alien Hymenoptera are mostly present in agricultural lands which are colonized by 65.0% of the alien species in this taxon, probably in relation with the multiple parasitoid releases that have occurred for biological control purposes. Greenhouses constitute another important man-made habitat type, which hosts most alien myriapods (64.7%) and thrips (55.8%).

Why do most introduced terrestrial arthropods apparently stay confined to human- modified habitats in their alien range of distribution? Several ecological conditions may be considered: i) disturbed urban and semi-urban areas may have a lower resistance to aliens, especially because of a lower pressure of potential natural enemies and, for phytophagous aliens, less vigorous host plants; ii) some species may prefer human-related habitats in their native range and are thus more likely to be carried into a new area by human transport, than species living in natural environments (Kenis et al. 2007). For instance, exotic ornamental plants are generally used in man-made habitats such as nurseries, parks and gardens and roadside plantings and shelter belts. Most alien phytophagous species introduced alongside these ornamentals remain as yet strictly associated with their original, exotic host (46.4% in Europe; Roques, 2008). They have not so far colonized native trees, and thus they develop only in parks and gardens and in hedgerows where such exotic plants are planted. A striking example

is that of the horse-chestnut leaf-mining moth *Cameraria ohridella*, which in its area of origin, the southern Balkans, lives in mountain ravines, whereas in its introduced area of Central and Western Europe, preferentially colonizes urban parks and gardens where its host tree has been extensively planted (Valade et al. 2009).

However, there could be a time-lag between the introduction to human habitats and adaptation and spread to natural habitats. Therefore, many alien species currently confined to human-made habitats should be monitored for their potential spread to natural areas (Roques et al. 2009). For instance, species such as the Asian longhorn beetles, *Anoplophora* spp., (Coleoptera, Cerambycidae) have the potential to live in urban areas, in cultivated lanes (e.g. those planted with poplars) as well as in natural forests where potential host plants occur. However, dispersal from man-made habitats to natural forests appears to be a slow process. For the first twenty-two years since its arrival in North America, *A. glabripennis* was restricted to trees in urban areas, but in 2008, it was found in natural forests dominated by *Acer* trees (Haack et al. 2010).

Finally, phytophagous species are predominant among the alien terrestrial arthropods, representing 47.2% (751 of 1590) of alien species to Europe, Parasitoids and predators only account for 32.6 % (518 spp.) whilst detritivores represent 20.8% (331 spp.). A few species exhibit several phytophagous guilds, whilst the habits of just 19 species are still unknown.

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Table 4.1. Comparative colonization of European habitats by the different taxonomic groups of terrestrial arthropods alien to Europe. The total number of established alien species observed in each habitat is figured. A species may have colonized several habitats. The percentage of species observed in the habitat with regard to the total number of alien species in the taxonomic group in Europe (last line) is given between brackets. 'Polyneoptera' includes Blattodea, Dermaptera, Isoptera, Orthoptera and Phasmatodea (see Chapter 13.3).

EUNIS categories	Crustacea	Myriapods	Aranea	Acari	Coleoptera	Diptera	Hemiptera	Hymenoptera	Lepidoptera	Phthiraptera	Polyneoptera[1]	Psocoptera	Siphonaptera	Thysanoptera	Zygentoma/ Collembolla
A- Marine habitats	-	-	-	-	-	-	-	-		-		-	-	-	-
B- Coastal habitats	-	3 (8.8)	-		12 (3.0)	6 (6.1)	2 (0.6)	-	2 (2.1)	-		-	-	-	-
C- Riparian habitats	-	-	-	6 (5.9)	5(1.3)	4 (4.1)	1 (0.3)	3 (1.0)	-	1 (3.2)		-	-	-	-
D- Mires, bogs, fens	-	1 (2.9)	-	-	3 (0.8)	4 (4.1)	1 (0.3)	1 (0.3)	-	-		-	-	-	-
E- Grasslands	-	2 (5.9)	6 (12.8)	2 (2.0)	24 (6.0)	6 (6.1)	19 (6.0)	8 (2.7)	3 (3.1)	4 (12.9)	7 (18.9)	-	2 (28.6)	3 (5.8)	-
F- Heathlands	-	2 (5.9)	6 (12.8)	9 (8.8)	39 (9.8)	4 (4.1)	16 (5.0)	4 (1.3)	13 (13.4)	1 (3.2)	2 (5.4)	-	1 (14.3)	2 (3.8)	-
G- Woodlands	3 (17.6)	4 (11.8)	6 (12.8)	10 (9.8)	77 (19.3)	12 (12.2)	61 (19.2)	74 (24.9)	19 (19.6)	8 (28.6)	1 (2.7)	12 (19.0)	2 (28.6)	2 (3.8)	-
H- Bare lands	-	2 (5.9)	6 (12.8)	-	2 (0.5)	1 (1.0)	1 (0.3)	2 (0.7)	2 (2.1)	-	1 (2.7)	2 (3.2)	-	-	-
I- Cultivated lands	-	3 (8.8)	6 (12.8)	33 (32.4)	87 (21.9)	18 (18.4)	91 (28.6)	193 (65.0)	25 (25.8)	-	7 (18.9)	1 (1.6)	-	7 (13.5)	1 (16.7)
I2/X- Parks, gardens	-	9 (26.5)	-	42 (41.2)	69 (17.3)	17 (17.3)	251 (78.9)	23 (7.7)	55 (56.7)	7 (14.3)	2 (5.4)	8 (12.7)	1 (14.3)	15 (28.8)	1 (16.7)
J- Urban, semi-urban	17 (100.0)	8 (23.5)	43 (91.5)	11 (10.8)	228 (57.3)	25 (25.5)	7 (2.2)	31(10.4)	33 (34.0)	21 (71.4)	20 (54.1)	40 (63.5)	5 (71.4)	1 (1.9)	3 (50.0)
J100 - Greenhouses	-	22 (64.7)	2 (4.3)	13 (12.7)	12 (3.0)	6 (6.1)	80 (25.2)	63 (21.2)	16 (16.5)	-	5 (13.5)	-	-	29 (55.8)	3 (50.0)
Total species	**17**	**34**	**47**	**102**	**398**	**98**	**318**	**297**	**97**	**31**	**37**	**49**	**7**	**52**	**6**